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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements relating to Filters

We, STONE FILTER COMPANY, INCORPORATED, of 900 Franklin Street, N. E. Washington, District of Columbia, United States of America, a corporation of the State of Maryland, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a filter provided with an end cap of thermoplastic resinous material, dissimilar from the filter medium, which is autogenously bonded to the medium.

In the following specification the term "autogenously bonded" is used to mean a bonding technique in which no bonding agent requires to be added or introduced between the parts which are joined together, the bond being achieved solely by virtue of the materials of which the parts themselves are made.

The composition and the manner of attachment of end caps to filters has presented numerous and troublesome problems over a period of many years. Metal end caps composed of common metals and alloys are susceptible to corrosion in contact with many materials encountered in filtration operations, and have been responsible for the introduction of undesirable foreign matter into the filtered material. Whereas metals not subject to such corrosion could be substituted on a theoretical basis, their cost is prohibitive. Moreover, the use of metal end caps as well as the use of end caps of other materials has usually required the interposition of an adhesive layer between the end caps and the medium, introducing the cost of an additional material, adding expense to assembly and always leaving substantial doubt as to whether or not a complete seal has been achieved between the end cap and the medium.

According to the invention there is provided a filter comprising a tubular porous shape comprising one or more layers of filter medium having an end and a cap of thermoplastic resinous material dissimilar from said medium autogenously bonded to said end by a friction weld between said end and said cap.

A preferred manner of effecting such autogenous bonds by the use of friction or spin welding, has been discussed at some length in "Application Design," Copyright 1961, by E. I. Du Pont de Nemours & Co. (Inc.), Wilmington, Delaware, pages 45 to 58. Whereas this publication has discussed the spin welding technique for bonding similar materials, the present invention is more concerned with the bonding of dissimilar materials, only one of which is composed of a thermoplastic resinous material. The technique is also described in the American Welding Society's "Welding Handbook" 4th edition (1960) Volume 3, at pages 48.14 to 48.18. As a matter of fact, the present invention has made it possible for the first time to effect a dependable bond between a filter medium and a thermoplastic resinous end cap.

The bonding achieved, by the technique of friction or spin welding already referred to, is effected solely by the frictional heat generated during the spinning, the joint being made without the addition of any other material such as bonding agents, solvents, cements or welding rods. The invention is eminently suited to filters wherein the medium comprises a layer of reinforced pleated paper, which reinforcement may assume the form of a thermosetting resin and/or attached textile threads or mesh of various types. The invention is also well suited to filters comprisng one or more layers of glass wool which may serve a coalescing function. The invention is also applicable to filters wherein the medium comprises a perforate layer such as a woven mesh or an otherwise perforate material. The invention has been successfully employed in conjunction with filters having media comprising multiple dissimilar

[*Price 4s. 6d.*]

layers of material, such as reinforced pleated paper, glass wool, loosely woven glass fabrics and perforated metal. The invention is also well suited for use with filters provided with porous covers or wraps to which the end cap is also autogenously bonded.

Preferred embodiments of the invention involve the use of end caps which are annular so as to provided a port for communication with the interior of a hollow filter. Such thermoplastic resinous caps will be applied to both ends of a filter in many applications of the invention. The end caps may be unitary and be provided with inner and outer flanges bonded to the inner and outer axial walls respectively, of the medium, whether such medium be composed of a single material or a plurality of materials or layers.

Some embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is an elevation of a filter embodying the present invention, partially broken away;

Figure 2 is a section taken along line 2—2 of Figure 1;

Figure 3 is a plan view of the filter shown in Figure 1;

Figure 4 is a fragmentary section, on a substantially enlarged scale, of a portion of the filter shown in Figure 1;

Figure 5 is an elevation, partially broken away, of another type of filter embodying the present invention; and

Figure 6 is a fragmentary section of the filter depicted in Figure 5.

The filter depicted in Figures 1 to 4 includes an internal layer 10 composed of pleated paper reinforced with a thermosetting resin applied thereto by impregnation or coating and further reinforced with a loosely woven mesh textile material 12. This reinforced pleated paper assembly is arranged in the form of a hollow body having inner folds 14 and outer folds 16 lying substantially in concentric cylindrical fashion. Surrounding the pleated paper element and in contact with its outer folds, there is provided a screen 18 composed of glass fibre mesh, and wound about this screen are several layers of felted glass fiber 20, which are in turn surrounded by a glass fiber mesh screen or outer wrap 22. As shown in Figure 1, the outer wrap 22 may be wound helically.

As also shown in Figure 1, to these composite layers of filter medium are applied the thermoplastic resinous end caps 24 which are bonded to the ends of the various layers constituting the filter so as to preclude all leakage, by the spin welding technique already mentioned. Suitable thermoplastic resins include those of the following types: polyethylene, polypropylene, acetal, acrylic, fluorocarbon, nylon and polymethyl methacrylate. In applying the spin welding technique to the assembly of the end caps with the filter media, either the end caps can be held in fixed positions and the media rotated, or the media held in fixed positions and the end caps rotated. In either case, when the rotational speed has assumed that required for the materials undergoing assembly, the two bodies will be brought into contact for a length of time sufficient to produce the desired degree of plasticity of the resin, whereupon the rotation will be abruptly stopped while the bodies are pressed into mutual engagement. This technique produces an autogenously bonded weld between the bodies without requiring the introduction of adhesives, crimping, or other assembly operations.

As clearly shown in Figure 4, the end cap 24 includes a radial wall 26, an inner axial flange 28 and an outer axial flange or skirt 30. The inner axial flange terminates in an enlarged portion 32 containing a groove 34 for the reception of a sealing member 36 such as an O-ring. Such a sealing element is adapted to engage a nipple which will be inserted through the port 38 defined by the inner axial flange for communication with the interior of the hollow filter.

By virtue of the spin welding technique, a bond 40 will be produced between the radial wall 26 of the cap and the end wall formed by the layers of medium, a bond 42 will be produced between the outer axial flange 30 and the outer wrap 22, and a bond 44 will be produced between the outer surface of the inner axial flange 28 and the inner folds 14 of the pleated paper element 10. As previously indicated, these bonds will be produced by virtue of the heat developed causing the thermoplastic material to flow sufficiently to produce the desired bond with the dissimilar materials to which the end caps are applied.

Figures 5 and 6 depict another embodiment of the invention in conjunction with a filter element 46 produced by helically winding a strip of creped paper impregnated with a thermosetting phenolic resin to produce an edge filter of hollow cylindrical form. To the ends of the filter elment 46, end caps 48 of thermoplastic resinous material dissimilar from the medium itself are applied to produce autogenous bonds between all mutually contacting surfaces. As shown in Figure 6, a portion of the radial wall 50 of the end cap 48 forms a bond 52 with the radial wall of the element 46, and the outer axial flange 54 forms a bond 56 with a portion of the outer peripheral wall of the element 46.

The end caps 48 are provided with inner axial flanges 58 to define ports 60 to receive suitable tubes or nipples, (not shown) for communication with the interior of the hollow element 46. The inner axial flange 58 depicted in Figure 6 provides an integral, inclined, internal lip 62 of sufficient resilience to engage the outer wall of an inserted tube or nipple to define a seal.

It should be clear from the foregoing, and from the appended claims, that the present invention is applicable to a large variety of filter media involving a single layer of material such as the pleated paper of Figure 1 to 4 or the helically wound crepe paper of Figures 5 and 6, or to composite constructions having multiple layers of materials, similar to one another or dissimilar from one another as in the case of Figure 1 to 4 where dissimilar layers are employed.

WHAT WE CLAIM IS:—

1. A filter comprising a tubular porous shape comprising one or more layers of filter medium having an end and a cap of thermoplastic resinous material dissimilar from said medium autogenously bonded to said end by a friction weld between said end and said cap.

2. A filter according to claim 1 wherein said shape comprises one or more layers of pleated paper.

3. A filter according to claim 1 or 2, wherein said shape comprises one or more layers of pleated paper reinforced with a thermosetting resin.

4. A filter according to any of the preceding claims wherein said shape comprises a layer of glass wool.

5. A filter according to any of the preceding claims wherein said shape comprises a perforate layer.

6. A filter according to claim 1 wherein said shape comprises an annular edge filter formed by helically winding a strip of creped paper reinforced with a thermosetting resin.

7. A filter according to any of the preceding claims wherein a porous cover surrounds said layer or layers of medium and said cap is also autogenously bonded to said cover.

8. A filter according to any of the preceding claims wherein said cap is annular to provide a port for communication with the interior of said hollow shape.

9. A filter according to any of the preceding claims wherein said shape has an annular end face at each end, and a cap of thermoplastic resinous material dissimilar from said medium is autogenously bonded by a friction weld to each of said end faces.

10. A filter according to any of the preceding claims wherein said cap is unitary.

11. A filter according to any of the preceding claims wherein said cap has an inner axial flange defining a port for communication with the interior of said hollow shape and an internal sealing member is carried by said flange.

12. A filter according to claim 11 wherein said inner axial flange is autogenously bonded to said medium.

13. A filter according to any of the preceding claims wherein said cap has an outer axial flange autogenously bonded to said medium.

14. A filter substantially as hereinbefore described with reference to the accompanying drawings.

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Chartered Patent Agents.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG.1

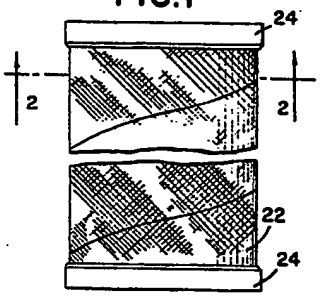
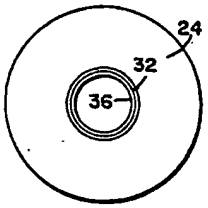


FIG.3



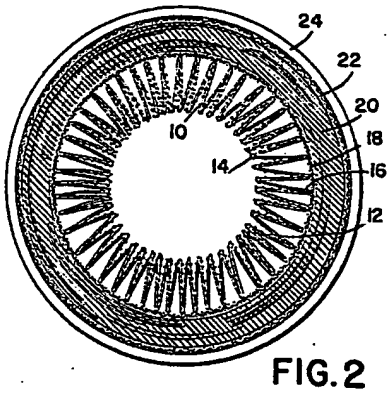


FIG.2

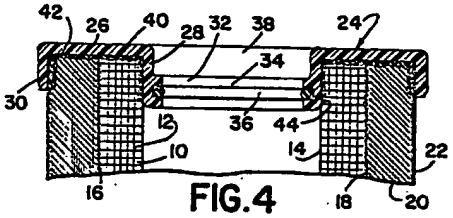


FIG.4

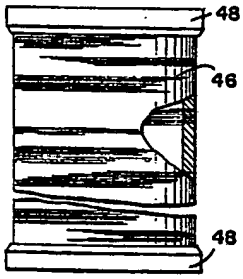


FIG.5

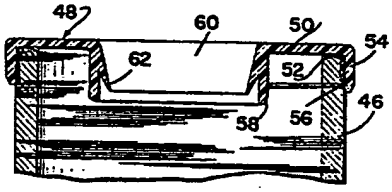


FIG.6